MIOSHA Fact Sheet

General Industry Safety & Health Division

Ethylene Oxide (EtO)

What is Ethylene Oxide (EtO)?

EtO is a colorless gas that has a sweet odor similar to ether when air concentrations are at or above approximately 700 parts per million (ppm). This odor threshold is well above permissible employee exposure limits. It also exists as a colorless liquid if the temperature is below 10 degrees Celsius. EtO gas, and liquid solutions with greater than 4% EtO, are extremely flammable. EtO gas is slightly heavier than air, may spread long distances if released, and can form an explosive mixture with air. Distant ignition from a spark or static charge and flashback are possible. EtO can also polymerize or decompose violently when exposed to high temperatures or other chemicals such as oxidizing agents, acids, bases, alcohols, or metals.

EtO is used as an intermediate in the manufacture of other chemicals such as textiles, detergents, polyurethane foam, antifreeze, solvents, adhesives, and other related products. It is also used as a fumigant in some agricultural products, and as a sterilizing agent for food (spices) or cosmetics, and used in hospitals or medical/dental clinics to sterilize a variety of medical equipment that cannot be sterilized by steam.

In addition to fire or explosion hazards, how can exposure to EtO affect me?

EtO is a known cancer and reproductive hazard. Acute exposures to EtO may result in respiratory irritation and lung injury, headache, nausea, vomiting, diarrhea, shortness of breath, and cyanosis (blue or purplish skin coloring due to lack of oxygen in the blood). Acute exposures to high concentrations can cause a buildup of fluid in the lungs (pulmonary edema) which is a medical emergency. Chronic exposure has been associated with cancer, reproductive effects, mutagenic changes, nerve damage, and sensitization. Contact with liquid EtO can result in skin/eye irritation or burns, damage to the cornea, or frost bite. Ingestion can result in gastric irritation or liver damage.

How does exposure to EtO occur?

Inhalation is the main route for occupational exposure to EtO. Skin or eye contact is second. Ingestion may be a route of occupational exposure if proper hygiene practices are not followed.

Is employee exposure to EtO regulated?

Yes, MIOSHA Occupational Health Standard, Part 304. Ethylene Oxide, regulates occupational exposures to EtO. This standard covers employee exposures to EtO in all employment situations. This standard includes the following employer requirements for EtO:

- **Permissible exposure limits** (PELs) for EtO. The action level (AL) is 0.5 parts per million parts of air (ppm) and the time-weighted average (TWA) is 1 ppm. Both of these exposure limits are based on an employee's TWA exposure for an eight-hour work day. There is also a 15 minute short term exposure limit (STEL) exposure based on a TWA of 5 ppm.
- Perform **initial air monitoring** to accurately determine employee exposures to EtO**.**
- Perform **periodic air monitoring** at least quarterly if initial monitoring indicates that employee exposures are at or above either the TWA or STEL. Perform periodic air monitoring at least every 6 months, when initial monitoring shows employee exposures are at or above the action level, and at least once a year if results indicate exposures are above the STEL.

- Establish a **regulated area** when employee exposures may exceed either the TWA or the STEL. Post warning signs and container labeling per Rule 19 and limit access to authorized personnel (people who have to work or be present in the area).
- Institute all **feasible engineering or work practice controls** to reduce employee exposure below the PELs. This can include local exhaust ventilation and safe employee work practices, but does **not include** employee job rotation.
- If TWA or STEL exposure limits are exceeded, establish and implement a **written compliance program** to reduce and maintain employee exposures at or below the PELs. Provide at least full face **respiratory protection** in accordance with Occupational Health standard Part 451, Respiratory Protection and according to Table 1 of Part 304, whenever the PELs are exceeded and feasible controls cannot reduce exposures below the PELs.
- Provide and ensure that employees wear **personal protective clothing or equipment** if it is possible that employees could have eye or skin contact with EtO or EtO solutions.
- Develop and implement **a written plan for emergency** situations if EtO is used in a workplace. The written emergency plan must comply with 29 CFR 1910.38 Employee Emergency Plans and Fire Prevention Plans.
- Provide **information and training** in all workplaces where there is potential exposure to airborne EtO at or above the AL or the STEL. Training is required at the time of initial assignment and at least annually for each employee.
- **Medical surveillance** by a licensed physician and without employee cost is required for all employees who are exposed to EtO at or above the AL or when the STEL is exceeded for at least 30 days a year. Medical surveillance is also required for employees who are exposed during an emergency.
- The following **Records** must be kept:
  - all air monitoring;
  - any objective data relied upon to meet the standard's requirements such as materials, operations, processes, etc.; and
  - records related to employee medical surveillance, etc.

Additional Information

Please visit the MIOSHA website at www.michigan.gov/mioshapublications where additional information may be available; or contact the Consultation, Education & Training Division at (517) 284-7720.

The **Agency for Toxic Substances and Disease Registry (ATSDR)**, based in Atlanta, Georgia, is a federal public health agency of the **U.S. Department of Health and Human Services**. This is an additional resource on the toxicology of EtO.
ATSDR ToxFacts sheet on EtO:
http://www.atsdr.cdc.gov/tfacts137.html